

CLAIMS

1. An ion implanter comprising:

5 an ion source for generating an ion beam at a first voltage V_0 ;
an analyzer for separating unwanted components from said ion beam;

a beam transport device for transporting said ion beam through said analyzer at a first transport energy;

10 a deceleration stage positioned downstream of said analyzer for decelerating said ion beam from said first transport energy to a final energy;

a beam filter comprising a magnet positioned downstream of said deceleration stage for separating neutral particles from said ion beam;

15 and

a target site for supporting a target for ion implantation, wherein said ion beam is transported through said beam filter and is delivered to said target site at said final energy.

20 2. An ion implanter as defined in claim 1 wherein said final energy is equal to the ion charge of ions in said ion beam times said first voltage V_0 .

25 3. An ion implanter as defined in claim 1 wherein said analyzer comprises an analyzing magnet and a resolving slit, wherein ions of a desired species are deflected by said analyzing magnet so as to pass through said resolving slit.

4. An ion implanter as defined in claim 1 wherein said beam filter comprises an angle corrector magnet for directing ions in said ion beam along substantially parallel trajectories.

5. An ion implanter as defined in claim 1 wherein the ion source comprises an arc chamber and a first power supply for biasing the arc chamber at said first voltage V_0 .

6. An ion implanter as defined in claim 5 wherein said target site is grounded.

7. An ion implanter as defined in claim 1 wherein said ion source includes means for generating a ribbon-shaped ion beam.

8. An ion implanter as defined in claim 7 further comprising a beam sensing and control assembly for adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

9. An ion implanter as defined in claim 1 further comprising at least one electron generator for supplying electrons to said ion beam.

10. An ion implanter as defined in claim 1 wherein said deceleration stage comprises a deceleration electrode for decelerating ions in said ion beam and a suppression electrode for suppressing flow of electrons in said ion beam from one energy region to another.

11. An ion implanter as defined in claim 10 wherein said deceleration electrode is movable in the direction of transport of said ion beam for adjusting beam focusing properties of said deceleration stage.

12. An ion implanter as defined in claim 10 wherein said deceleration stage focuses said ion beam in a vertical plane for improving beam transmission to the target.

13. An ion implanter as defined in claim 5 wherein said beam transport device comprises a second power supply for biasing components of said analyzer at a second voltage V_1 that in part defines said first transport energy.

14. An ion implanter as defined in claim 13 wherein said ion source and said beam transport device are configured such that said first transport energy is equal to $q_i (V_0 + V_1)$, where q_i is the ion charge.

15. An ion implanter comprising:
an ion source for generating an ion beam at a first voltage V_0 ;
an analyzer for separating unwanted components from said ion beam;
a first beam transport device for transporting said ion beam through said analyzer at a first transport energy;
a first deceleration stage positioned downstream of said analyzer for a decelerating said ion beam from said first transport energy to a second transport energy;
a beam filter positioned downstream of said first deceleration stage for separating neutral particles from said ion beam;

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a second beam transport device for transporting said ion beam through said beam filter at said second transport energy;

a second deceleration stage positioned downstream of said beam filter for decelerating said ion beam from said second transport energy to
5 a final energy; and

a target site for supporting a target for ion implantation, wherein said ion beam is delivered to said target site at said final energy.

16. An ion implanter as defined in claim 15 wherein said final energy is
10 equal to the ion charge of ions in said ion beam times said first voltage V_0 .

17. An ion implanter as defined in claim 15 wherein said analyzer
15 comprises an analyzing magnet and a resolving slit, wherein said analyzing magnet deflects ions of a desired species in said ion beam through said resolving slit.

18. An ion implanter as defined in claim 15 wherein said beam filter
20 comprises a magnet for deflecting ions in said ion beam.

19. An ion implanter as defined in claim 15 wherein said beam filter
comprises an angle corrector magnet for deflecting ions in said ion beam along substantially parallel trajectories toward said target site.

20. An ion implanter as defined in claim 15 wherein the ion source
25 comprises an arc chamber and a first power supply for biasing the arc chamber at said first voltage V_0 .

21. An ion implanter as defined in claim 15 wherein said ion source includes means for generating a ribbon-shaped ion beam.

22. An ion implanter as defined in claim 21 further comprising a beam sensing and control assembly for adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

23. An ion implanter as defined in claim 15 further comprising at least one electron generator for supplying electrons to said ion beam.

24. An ion implanter as defined in claim 15 wherein said first and second deceleration stages each include a deceleration electrode for decelerating ions in said ion beam and a suppression electrode for suppressing flow of electrons in said ion beam from one energy region to another.

25. An ion implanter as defined in claim 24 wherein the deceleration electrode of said first deceleration stage is movable in the direction of transport of said ion beam for adjusting beam focusing properties of said first deceleration stage.

26. An ion implanter as defined in claim 24 wherein said first deceleration stage focuses said ion beam in a vertical plane for improving beam transmission to the target.

27. An ion implanter as defined in claim 20 wherein said first beam transport device comprises a second power supply for biasing

components of said analyzer at a second voltage V_1 that in part defines said first transport energy.

28. An ion implanter as defined in claim 27 wherein said second beam transport device comprises a third power supply for biasing said beam filter at a third voltage V_2 that in part defines said second transport energy.

29. An ion implanter as defined in claim 28 wherein said ion source, said first beam transport device and said second beam transport device are configured such that said first transport energy is equal to $q_i (V_0 + V_1)$, where q_i is the ion charge, and said second transport energy is equal to $q_i (V_0 + V_2)$.

30. A method for implanting ions in a target, comprising the steps of:
generating an ion beam at a first voltage V_0 ;
separating unwanted components from said ion beam in an analyzer;
transporting said ion beam through the analyzer at a first transport energy;
decelerating said ion beam from said first transport energy to a final energy downstream of said analyzer;
separating neutral particles from said ion beam in a beam filter comprising a magnet, after decelerating said ion beam from said first transport energy to said final energy; and
delivering said ion beam to a target site at said final energy.

31. A method as defined in claim 30 wherein said final energy is equal to the ion charge of ions in said ion beam times said first voltage V_0 .

32. A method as defined in claim 30 further comprising the step of suppressing flow of electrons in said ion beam from one energy region to another.

33. A method as defined in claim 30 wherein the step of separating neutral particles from said ion beam comprises deflecting ions in said ion beam along substantially parallel trajectories with an angle corrector magnet.

34. A method as defined in claim 30 wherein the step of transporting said ion beam through the analyzer comprises biasing components of the analyzer at a second voltage that in part defines said first transport energy.

35. A method as defined in claim 30 wherein the step of generating an ion beam comprises generating a ribbon-shaped ion beam and wherein the step of delivering said ion beam to a target site comprises adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

36. A method as defined in claim 30 further comprising the step of supplying electrons to said ion beam to limit expansion of said ion beam.

37. A method for implanting ions in a target, comprising the steps of:
generating an ion beam at a first voltage V_0 ;

separating unwanted components from said ion beam in an analyzer;

transporting said ion beam through the analyzer at a first transport energy;

5 decelerating said ion beam from said first transport energy to a second transport energy in a first deceleration stage positioned downstream of said analyzer;

separating neutral particles from said ion beam in a beam filter positioned downstream of said first deceleration stage;

10 transporting said ion beam through said beam filter at said second transport energy;

decelerating said ion beam from said second transport energy to a final energy in a second deceleration stage positioned downstream of said beam filter; and

15 delivering said ion beam to a target site at said final energy.

38. A method as defined in claim 37 wherein said final energy is equal to the ion charge of ions in said ion beam times said first voltage V_0 .

20 39. A method as defined in claim 37 wherein the step of separating neutral particles from said ion beam comprises deflecting ions in said ion beam with a magnet.

25 40. A method as defined in claim 37 wherein the step of separating neutral particles from said ion beam comprises deflecting ions in said ion beam along substantially parallel trajectories with an angle corrector magnet.

41. A method as defined in claim 37 wherein the step of transporting said ion beam through the analyzer at a first transport energy comprises biasing components of the analyzer at a second voltage that in part defines said first transport energy.

42. A method as defined in claim 41 wherein the step of transporting said ion beam through said beam filter at said second transport energy comprises biasing said beam filter at a third voltage that in part defines said second transport energy.

43. A method as defined in claim 37 wherein the step of generating an ion beam comprises generating a ribbon-shaped ion beam and wherein the step of delivering said ion beam to a target site comprises adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

44. A method as defined in claim 37 further comprising the step of supplying electrons to said ion beam for limiting expansion of said ion beam.

45. An ion implanter comprising:
an ion source for generating an ion beam and accelerating said ion beam at a first voltage V_0 ;
a beamline module containing one or more beamline components for modifying said ion beam;
means for transporting said ion beam through said beamline module at a first transport energy;
a beam filter positioned downstream of said beamline module for separating neutral particles from said ion beam;

5 a deceleration stage disposed between said beamline module and said beam filter for decelerating said ion beam from said first transport energy to a final energy; and

a target site for mounting a target for ion implantation, wherein said ion beam is transported through said beam filter and is delivered to said target site at said final energy.

46. An ion implanter as defined in claim 45 wherein said means for transporting said ion beam through said beamline module at a first transport energy comprises a power supply for biasing components of said beamline module at a second voltage V_1 that in part defines said first transport energy.

47. An ion implanter as defined in claim 46 wherein said beamline module comprises an analyzer for separating unwanted components from said ion beam.

48. An ion implanter as defined in claim 45 wherein said beam filter comprises an angle corrector magnet for directing ions in said ion beam along substantially parallel trajectories.

49. An ion implanter as defined in claim 45 wherein said deceleration stage comprises a deceleration electrode for decelerating ions in said ion beam and a suppression electrode for suppressing flow of electrons in said ion beam from one energy region to another.

50. An ion implanter as defined in claim 45 wherein said ion source comprises means for generating a ribbon-shaped ion beam, said ion

implanter further comprising a beam sensing and control assembly for adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

- 5 51. An ion implanter as defined in claim 45 further comprising at least one electron generator for supplying electrons to said ion beam for limiting beam expansion.

52. An ion implanter comprising:

10 a ion source for generating an ion beam and accelerating said ion beam at a first voltage V_0 ;

a first beamline module containing one or more beamline components for modifying said ion beam;

15 first means for transporting said ion beam through said first beamline module at a first transport energy;

a second beamline module positioned downstream of said first beamline module, said second beamline module comprising a beam filter for separating neutral particles from said ion beam;

20 a first deceleration stage disposed between said first and second beamline modules for decelerating said ion beam from said first transport energy to a second transport energy;

second means for transporting said ion beam through said second beamline module at said second transport energy;

25 a target site positioned downstream of said second beamline module for mounting a target for ion implantation; and

a second deceleration stage disposed between said second beamline module and said target site for decelerating said ion beam

AY from said second transport energy to a final energy, wherein said ion beam is delivered to the target site at said final energy.

53. An ion implanter as defined in claim 52 wherein said ion source
5 comprises an arc chamber and a first power supply for biasing the arc
chamber at said first voltage V_0 , wherein said first means for transporting
said ion beam comprises a second power supply for biasing components
of said first beamline module at a second voltage V_1 that in part defines
said first transport energy and wherein said second means for
10 transporting said ion beam comprises a third power supply for biasing
said second beamline module at a third voltage V_2 that in part defines
said second transport energy.

54. An ion implanter as defined in claim 53 wherein said first beamline
15 module comprises an analyzer for separating unwanted components
from said ion beam and wherein said beam filter comprises an angle
corrector magnet for directing ions in said ion beam along substantially
parallel trajectories.

20 55. An ion implanter as defined in claim 54 wherein said first and
second deceleration stages each include a deceleration electrode for
decelerating ions in said ion beam and a suppression electrode for
suppressing flow of electrons in said ion beam from one energy region to
another.

25 56. An ion implanter as defined in claim 52 wherein said ion source
comprises means for generating a ribbon-shaped ion beam, said ion
implanter further comprising a beam sensing and control assembly for

adjusting said ribbon-shaped ion beam to be substantially uniform across its width.

57. An ion implanter as defined in claim 52 further comprising at least
5 one electron generator for supplying electrons to said ion beam for
limiting beam expansion.

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